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ENGINEERING EVALUATION/FACT SHEET

B ACKGROUND INFORMATION

Application No.:	R13-3308
Plant ID No.:	039-00003
Applicant:	Union Carbide Corporation
Facility Name:	South Charleston Site
Location:	South Charleston
NAICS Code:	325199
Application Type:	Construction
Received Date:	April 11, 2016
Resubmitted:	September 9, 2016
Engineer Assigned:	Edward S. Andrews, P.E.
Fee Amount:	$3,500.00
Date Received:	September 9, 2016
Complete Date:	October 20, 2016
Due Date:	January 1, 2017
Applicant Ad Date:	April 11, 2016
Newspaper:	*The Charleston Gazette*
UTM's:	Easting: 440.026 km Northing: 4,246.927 km Zone: 17
Description:	The application is for the construction of a treatment system to handle contaminated groundwater.

DESCRIPTION OF PROCESS

Union Carbide Corporation (UCC) owns and operates the South Charleston Site, which is located in South Charleston of Kanawha County in West Virginia. UCC operates several chemical manufacturing units and support activities at this location. In 1999, UCC entered into a "Facility Lead Agreement" with U.S. EPA Region III to investigate, and ,if necessary, develop workplans to remediate the release of waste and/or waste constituents from the South Charleston Site. The proposed treatment system is one of the projects that UCC has agreed to perform under this "Lead Agreement" with U.S. EPA.

For Phase 1, the area was divided into 3 groundwater capture zones based on groundwater modeling conducted using the MODFLOIV-NWT code in conjunction with the Groundwater Vista pre- and post-processing software. The average concentration for each capture zone was determined based on the groundwater analytical data applicable to that capture zone. The predicted groundwater influent flowrate is anticipated to be 30 gallons per minute (gpm) total from the 3 capture zones.

However, UCC scaled this value up for design purposes to 100 gpm. (Thus, the mass basis of contaminants more than doubled based on this contingency factor for the flow rate). The process train is meant to treat the VOCs in aqueous form; however, there are high iron concentrations in the groundwater. Iron can negatively affect the wetland performance; as a result, a cascade aerator is included to oxidize the iron, which is then precipitated and settled out in the clarifier. A maximum of 470 standard cubic feet per minute (scfm) of atmospheric air will be introduced into the aerator and as a side effect, a portion of the VOCs will volatilize during this process. The emission estimates submitted in April 2016 with the original permit application conservatively assumed 99.99% of the VOCs would volatilize.

Subsequent to that submittal, the design has progressed and equipment vendors have been selected. The cascade aerator vendor has indicated a range of 20 to 40% of benzene would volatilize based on their equipment design. To be conservative, revised emission estimates were based on 40% volatilization of benzene through the cascade aerator, with volatilization rates for other VOCs being scaled based on each chemical's Henry's Law constant in relation to benzene's Henry's Law constant.

As noted above, prior to detailed design and availability of vendor information, we had conservatively estimated emissions at nearly 100% volatilization along with the scaled up groundwater flowrate of 100 gpm. Per the DAQ subsequent request on September 20, 2016, UCC have prepared an emissions scenario that evaluates emissions using the modeled rate of groundwater flow from the capture zones with 99.99% volatilization to demonstrate that total uncontrolled VOCs emissions are below 40 TPY. The model predicted a flowrate of approximately 30 gpm; however, 50 gpm was utilized in this emissions scenario to be conservative. At this flow rate and assuming 99.99% volatilization, total uncontrolled VOC emissions are 33 TPY. It should be noted that this estimate does not appropriately estimate emissions under operating conditions, as the goal of the treatment system is to treat VOCs in the aqueous form.

This writer used the process data provided in the application and developed a process simulation using ProMax 4.0 from Bryan Engineering and Research. This simulation used the concretizations of the contaminants which are presented in the following table:

simulation with the flow rate at the inlet at 100 gpm to established worst case short term emissions of VOHAPs from the oxidizer. This simulation yields an hourly emissions rate of 0.69 pounds of HAPs per hour, which included hydrogen chloride (HCl). HCl is generated from the incineration of chlorinated compounds (i.e. chlorobenzene).

For establishing annual emission limits, the writer adjusted the inlet flow rate to 50 gpm in the simulation with the concentration of the VOHAPs at 499.8 ppm. This simulation yielded an annual emission rate of 1.92 tons of total HAPs per year and 1.85 tons of VOCs per year. Of the total HAPs, benzene emissions accounts for 1.74 tons of the 1.92 tons per year.

Table #2 – Maximum Predicted Inlet loading to the Oxidizer & Outlet from the Oxidizer		
Contaminate	Inlet Loading to the Oxidizer (lb/hr)	Emission Rate from the Oxidizer (lb/hr)
1,2-Dichloroethane	0.01791	0.0009
1,3-Dichlorobenzene*	0.000004	0.0000002
1,4-Dichlorobenzene	0.000005	0.0000003
2-Butanone*	0.0011	0.00006
Acetone*2	0.0763	0.0038
Benzene	7.9637	0.3982
Chlorobenzene	0.0002	0.00001
cis-1,2-Dichloroethylene*	0.0068	0.0003
Ethylbenzene	0.03211	0.0016
Naphthalene	0.0012	0.00006
Styrene	0.0244	0.0012
Toluene	0.2998	0.0150
Xylene	0.0943	0.0047
Hydrogen Chloride[1]	0	0.0175
Total	8.52	0.44
Total VOC	8.44	0.44
Total HAP	8.44	0.44

* Compound is not classified as HAP.
1 Hydrogen Chloride emissions a produce from combusting chloride compounds (i.e. 1,3-Dichlorobenzene, Chlorobenzene).
2 Compound is not classified as a VOC.

Other emissions from the oxidizer are products of complete or incomplete combustion, which are carbon monoxide (CO), oxides of nitrogen (NO_x), particulate matter (PM), PM less than 10 micros (PM_{10}), PM less than 2.5 micros ($PM_{2.5}$), and carbon dioxide (CO_2) as a greenhouse gas. The applicant claimed that formation of PM, CO and NO_x would not occur in the proposed oxidizer. The writer does not agree with the applicant predicted emission rates.

The proposed oxidizer will use electric heating elements to maintain the temperature to promote the oxidation reaction. The excess air (oxygen and nitrogen) that inject in the cascade aerator will be routed to the oxidizer with the striped out hydrocarbons. Based on the

The South Charleston Site is and will remain classified as a Major Source under Title V for criteria and hazardous air pollutants. Union Carbide Corporation is required to incorporate this permit into the facility Title V Operation Permit. The applicant will be required to incorporate the applicable requirements into the facility's Title V Operating Permit within 12-months after start-up of the system.

In the original application, UCC claimed to be exempt from the requirements of Subpart GGGGG of Part 63 by an exclusion under 40 CFR 63.7881(b)(3). The writer requested a copy of the Resource Conservation and Recovery Act (RCRA) order that required the applicant to conduct the proposed remediation. The applicant produced an October 26, 1999 Letters of Commitment for Union Carbide's Technical Center, South Charleston Plant and PTO Facility.

The writer did not consider the letters as an official order from the Administrator that required action on the applicant part. Basically, the letter is UCC is written request to participate in U.S. EPA Region III's Facility Lead Program. Thus, the Letter of Commitment is not binding and therefore is not considered as an order.

Therefore, the proposed groundwater remediation project is subject to Subpart GGGGG. 40 CFR 63.7886 outlines the general standards for the source to comply with in Subpart GGGGG. UCC has selected to meet the less than 500 ppmw (part per million by weight) of average total VOHAP option (See 40 CFR §63.7886(b)(2)). If the inlet concentration of the media being remediated is less than 500 ppmw, than all remediation material management units downstream from the point of determination managing this material meets this standard unless additional material is added that potentially could increase this concentration. For this proposed project, UCC will not be adding additional containment groundwater downstream of the oil/water separator.

UCC is believes that the VOHAP concentration in the groundwater entering the treatment system to be less than 300 ppmw, see Table #1 in the "ESTIMATE OF EMISSION BY REVIEWING ENGINEER" section of this evaluation. Thus, the applicant should not have any issues meeting the standard under 40 CFR §63.7886(b)(2). The applicant will be required to conduct measurement to demonstrate compliance with the 500 ppmw standard as outlined in 40 CFR §63.7943.

This subpart has a requirement for equipment leaks as outlined in 40 CFR §63.7882(a)(3). Equipment in contact with a remediation material that has or potential to have a total HAP concentration of 10% by weight or greater is subject the Leak Detection and Repair Program (LDAR) of this subpart. The writer estimated the maximum concentration of total HAP to be less than 3% by weight and therefore the LDAR requirements of Subpart GGGGG do not apply.

No other federal regulations are applicable to the proposed treatment process. However, the catalytic oxidizer is subject to 45 CSR 6 for particulate matter and visible emissions. 45 CSR §6-4.1 establishes allow PM rate based on incinerator capacity. The allowable standard for this oxidizer would be 0.04 pounds per hour, which is based on the 13.07 pounds of containments

The flowrate of aerator air needs to be sufficient to completely oxidize the iron in the groundwater before it is introduced to the vertical flow vegetated contact beds. This flow rate should be regulated based on the amount of iron in the water. The writer modeled the cascade aerator at the maximum air flow rate. Thus, the maximum air flow rate is fixed and the oxidizer should be designed and constructed to allow additional combustion air to completely oxidize the organics in the effluent. The writer believes that additional monitoring would not add any benefit in determining compliance than the typical monitored parameters for oxidizers (i.e. visible emissions & temperature).

Monitoring the daily average temperature difference across each catalyst bed and comparing it to the minimum temperature difference established during the design evaluation or performance testing to ensure the catalyst is maintaining it reactively towards the contaminants. In addition to monitoring the temperature difference, the applicant proposed to sample and analyze the catalyst from each of the bed on an annual basis to determine when the catalyst beds need to be replaced.

The writer has proposed to require the applicant to conduct an initial performance test to demonstrate initial compliance with the emission limits and to established the minimum temperature difference. The writer proposed a requirement to conduct subsequent testing be based on the VOHAP concentration in the groundwater entering the system rather than a set frequency. The writer proposes to set this concentration at 80% of the Subpart GGGGG trigger level of 500 ppmw, which equates to 400 ppmw.

To ensure that the permittee maintain a closed-vent system with no detectable leaks, the writer adopted leak detection and repair (LDAR) from Subpart GGGGG which refers to Subpart DD of Part 63.

RECOMMENDATION TO DIRECTOR

The information provided in the permit application indicates the proposed changes of the facility will meet all the requirements of the applicable rules and regulations when operated in accordance with the permit application. Therefore, the writer recommends granting Union Carbide Corporation a Rule 13 Construction Permit for the construction of a groundwater remediation system at South Charleston Site located in South Charleston, WV.

Edward S. Andrews, P.E.
Engineer

December 23, 2016
Date

west virginia department of environmental protection

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Jim Justice, Governor
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MEMORANDUM

To: Beverly McKeone, P.E. – New Source Review Program Manager

From: Ed Andrews, Engineer

Date: June 7, 2017

Subject: Changes to Permit R13-3308 after DAQ Public Notice for Union Carbine Corporation 039-00003

During the public period for Permit Application R13-3308, Union Carbide Corporation (UCC) submitted comments to the agency on January 26, 2017, which was received with the public comment period that ended on January 27, 2017. A response to UCC was submitted on March 9, 2017, which included another draft that incorporated changes as result of the January 26, 2017 comments.

On March 25, 2017, the DAQ received a follow-up e-mail in the form a second set of responses made by UCC. This response was follow-up with a meeting on May 2, 2017, with representatives from UCC to include their consultant 2CHEM Hill. The main changes that UCC ask the agency to consider is listing in the following:

- Include the applicable requirements from the Remediation MACT.
- Reconsider limiting water throughput through the MIGCS.
- Reconsider the averaging period for the determining the average total concentration of VOHAPs in the water to be remediated.
- Reconsider the number of samples to determine the average total concentration of VOHAPs in the contaminated water.
- Operating parameters for the control device (CATOX).
- Reconsider the visible emission observations.
-

Additional information from 2CHEM Hill was provided to the agency during the meeting, which was description of the process and the control device manufacturer's layout of the CATOX system and support equipment associate with it. After the meeting, UCC outline which sources of the MIGCS are subject to the applicable provisions of the Remediation MACT.

Most the changes presented in the finial permit for consideration compared to the draft that the public was given the opportunity to review and comment on are due to how the Remediation MACT defines affected sources and corresponding emission standards.

It was implied and understood that the whole MIGCS system was subject to the Remediation MACT and compliance with the rule by handling and treating contaminated groundwater with an average total VOHAP concentration of 500 ppm by weight or less. This is not the case for this MACT Standard.

The Remediation MACT defines the equipment or activities that is involved with the remediation into three groups, which are *Process Vents, Remediation Material Management Units,* and *Equipment Leaks.* Each of the groups has its own standards and requirements within the MACT.

To simplify following discussion, UCC claims and this writer agrees with that the equipment associated with the MIGCS will not be in contact with remediation material having a contact of VOHAP greater than 10%. Thus, no equipment with the MICGS would fall under the *Equipment Leaks* group of this MACT.

In this rule, *Process Vents* of an affected source is defined as the entire group of process vents associated with the in-situ and ex-situ remediation processes used at the site to remove, degrade, transform, or immobilize hazardous substances in the remediation material. Thus, the equipment with the cascade aerator and vertical flow vegetated contact beds are classified as *Process Vents* under the Remediation MACT. UCC had proposed to vent the off gas from these units, which includes the oil/water separator, sumps, flocculation & flash mixing tanks, clarifier, and siphon tank to a *close vent system*, which is routed to a control device that has a minimum destruction efficiency of 95% or better (CATOX). This meets the emission standard of 40 CFR §§63.7890(b)(3) or (4). Thus, the following changes to the draft had to be made to the final permit due to applicability of the permitted towards this rule.

Table 1 – Changes Made to Account Process Vent Requirements

Condition No.	Summary of Change	Notes
4.1.1.c.	Identified affects sources required to be routed to closed vent system.	
4.1.1.c.i.	UCC has elect to operate a neg. pressure system, which is allowed per §63.7882	UCC provide updated flow diagrams which notes the pressure of the system.

Added 4.1.1.j, k. & l.	MACT requires a monitoring plan for the CATOX, SSM provision, and requirement to develop a SSMP.	Requirements from the rule. (See §§63.7935(a), (c), (g) & (h))
4.1.2.i.ii. & 4.1.2.i.iii.	Rule requires specify monitoring of the temperature difference across the catalyst bed for catalytic oxidation control device & work practice to replace the bed.	Rule does not call for monitor of the temperature of the catalytic oxidizer. (See §63.7925(g)(5))
Added 4.1.2.j.	Rule allows for periods of planned maintenance of no more than 240 hours per year.	See §63.7925(b)(1)
4.2.3.	Rule required monitoring in intervals of at least once every 15 min. Set requirements for QA/QC.	The monitoring system for the CATOX must meet the requirements of a CPMS under the rule.
4.2.5.	Updated the monitoring of the closed vent system to conform with the rule.	See §63.7928(b)(2)
4.2.6.	Omitted condition.	Requirements were address in Condition 4.2.5. for the use of a neg. pressure vent system.
4.3.1. & 4.3.2.	Rule outline the use of Method 18 and repeat testing when authorized by Section 114 of the CAA	See §63.7940 & §63.7942 and §63.7(3)
Added 4.4.4.	Conditions outline recordkeeping requirements for NOCS, SSM, test reports and affect sources not subject to control requirements per the MACT.	See §63.7952(a)
Added 4.4.5.	Added recordkeeping for the planned maintenance of the CATOX per the rule.	See 63.7952(d)

UCC has made a case that the Δ T across the bed may not be a good parameter to indicate proper operation of the CATOX. However, the rule is very clear that the daily average ΔT shall be used for catalytic oxidizer as an indicator of compliance. Because, the activities involved in the shakedown period after startup of the MIGCS may limit or restrict the VOHAP that is seen by the catalysis bed. Without any VOHAP in the effluent, there would not be a exothermic reactor taking place across the catalysis bed which would results on in no ΔT across the bed (non-compliance period). Therefore, this writer recommends to omit an interim ΔT or any other operating parameter for the CATOX and only established one in accordance with the Remediation MACT through performance testing.

Other issues that UCC had objected to during the comment period and afterwards were other indicators of proper operation of the CATOX and monitoring of visible emissions. UCC does not believe that no visible is a good indicator of proper operation of the CATOX. This writer disagrees with this position. A reasonable compromise was reached by allowing visible emission for more than 5 minutes within a two-hour period and developing a tier monitoring schedule (See Conditions 4.1.2.i.i. and 4.2.4.).

The Remediation MACT defines an affected source under *Remediation Material Management Units* as an entire group of remediation material management units that is used for site remediation activities. The definition goes on further to excludes unit(s) that are equipped with a vent. The unit is then classified as a *Process Vent* and subject to the *Process Vent* requirements. The sources associate with the MIGCS that meet the definition of a *Remediation Material Management Unit* are the container for the oil/water separator, the process pipping (transfer system), and the horizontal flow vegetated contact beds.

UCC claimed that the oil/water separator as being an affect source under the *Process Vents* and *Remediation Material Management Units* groups. This writer does not believe this is not the correct classification under §63.7882. The rule notes if the Remediation Material Management Unit is equipped with a vent that serves as a process vent then it is not a *Remediation Material Management Unit* and is a *Process Vent*. Under 40 CFR 63.7957, *Process vents means any open-ended pipe, stack, duct, or other opening intended to allow the passage of gases, vapors, or fumes to the atmosphere and this passage is caused by mechanical means (such as compressors, vacuum-producing systems or fans) or by process-related means (such as volatilization produced by heating). For the purposes of this subpart, a process vent is neither a safety device (as defined in this section) nor a stack, duct or other opening used to exhaust combustion products from a boiler, furnace, heater, incinerator, or other combustion device.*

Therefore, oil/water separator is equipped than it is group as a *Process Vent* and subject to the *Process Vent* control requirements. Likewise, the horizontal flow vegetated contact beds are not equipped with a vent and therefore are subject to the requirement as a Remediation Material Management Units.

UCC claim that these units would handle or process remediation material with a VOHAP concentration of less than 500 ppm by weight, which is one of the compliance options of the general standards for *Remediation Material Management Units* of this MACT standard (See 40 CFR 63.7886(b)(2)). During the comment period and afterwards, UCC objected to the monthly

averaging period and weekly sampling to determine compliance with the 500 ppm standard. UCC suggested implementing the minimum frequency as outline in the rule, which is no less than four samples average over a year.

During the review, public comment period and afterwards of the public comment period, UCC made unsupported claims that the VOHAP concentration should be under 300 ppm. Because the of the shakedown period will involve varying the water flowrate to initial fill the system and initiate the microorganisms to break down the VOHAPs, some of the weekly samples might not represent the complete range of HAP compositions and HAP quantities during the averaging period.

It was suggested to adjust the averaging period based on the concentration previous averaging period. This writer believes this would cause confusion for all party involve in determination and varying compliance. Thus, the writer recommends to adjust the minimum number of samples needed to be used during the averaging period based on previous averaged concentration of VOHAPs. Also, set the averaging period on a 12-month basis, which is allowed under the rule.

The criteria used to develop the Schedules 1 and 2 in the following table was based on 80% of the applicable threshold of the general standard from the rule (500 ppm), which equates to 400 ppm. In EPA's Enforcement and Compliance Guidance, it is generally understood if a source or emission unit is less than 80% of a applicable standard or limit then it is operating within compliance. If over 80%, then further investigation is warrant to ensure compliance. Thus, the number of minimum samples increase once the VOHAP concentration of the previous averaging is above the 400 ppm or with 80% of 500 ppm general standard.

This writer developed the next set point in sampling schedule based on 80% of the applicant's claim of the maximum anticipated VOC concentration of 304 ppm. The applicant used this VOC concentration to determine the maximum inlet load to the CATOX is based on, which was predicted to be 8.74 pounds of VOC per hour. The actual hourly emission limit was based on inlet load of 13 pounds of VOC per hour. Thus, average VOHAP concentration less than 240 ppm should warrant the minimum level of detail in demonstrating compliance. Therefore, the minimum number of samples is set to the minimum number as stated in the MACT.

Table 2 Sampling Schedule

Schedule No.	Criteria of Schedule* (ppmw)	Minimum No. Samples Required for the 12-month average	Timing of sampling
1	Above 400	12	Monthly
2	At 400 and above 240	6	Bi-monthly
3	Less than 240	4	Quarterly

To address the agency concern of capturing an enough data to represent the VOHAPs concentration over the entire averaging period, this writer recommends that the initial averaging period VOHAO concentration shall be determined using 12 samples with one sample being collected for each month, which is the same as Schedule 1 in the above table. This sampling schedule should address UCC's and the DAQ;s concerns while still conforming to the requirements outline in 40 CFR 63.7943. This schedule was inserted into Condition 4.2.1.

Other changes to the draft that pertain to the Remediation Material Management Units are outline in the following table.

Table 1 – Changes Made to Account Remediation Material Management Unit Requirements

Condition No.	Summary of Change	Notes
4.1.1.a.	Condition was change to state the averaging period is set on a 12-month basis	Allowed under §63.7943(b)(i)
4.1.1.b.	Establish a total amount of VOHAP material to be process and limited the flowrate to design capity	These values were state in the application.
Condition 4.1.1.d. & f.	These conditions state the general standard horizontal bed and transfer system for the oil/water separator from the MACT.	Requirements from the rule. (See §§63.7886(b)(2)
4.1.h.	Condition was change to conform to the rule for transferring treated material off site.	See 63.7936(a)
Added 4.1.1.i.	Condition was added for the transfer of treated material from the oil/water separator to off site.	See §63.7925(a)
4.2.2.	Change the from the monitor the water flow rate to monitor and record instance the hourly flowrate is above 100 gpm (max. design)	Monitoring is need for to demonstrate compliance with Condition 4.1.1.b.

4.2.5.	Updated the monitoring of the closed vent system to conform with the rule.	See §63.7928(b)(2)
4.2.6.	Omitted condition.	Requirements were address in Condition 4.2.5. for the use of a neg. pressure vent system.
4.3.1. & 4.3.2.	Rule outline the use of Method 18 and repeat testing when authorized by Section 114 of the CAA	See §63.7940 & §63.7942 and §63.7(3)
Added new 4.4.6.	Conditions is required to demonstrate compliance for the outlet conc. limit of Conditions 4.1.1.i and j..	See §63.7936(a) & §63.7940(c)
4.5.2.	This condition incorporated the Notification of Compliance Status (NOCS) as required by the MACT	See §63.7950(e)(1), §63.9(h)(2)(ii) & §63.10(d)(2)
4.5.3.	Condition 4.5.2. was replaced and renumber. The MACT requires compliance reports be submitted in accordance with the rule.	See §63.7951(b)

Other changes to the permit that were not due to the applicability of the Remediation MACT is the monitoring of visible emissions from the CATOX. To resolve the objections made by UCC regarding the visible emission monitoring, a tier approach was developed based on the results of the past 3 observations, which is present in the following table and incorporated in the Permit in Condition 4.2.4.

Table 4 – Method 22 Observation Schedule		
Schedule No.	**Frequency of Observations**	**Minimum No of days between Observations (days)**
1	Monthly	20
2	Quarterly	60
3	Annually	270

If visible emission is observed, the permittee must take corrective action and will resume observations on Schedule No. 1.

There were no changes to any of the emissions limits that in the draft made available to the public verse the version that this writer is recommending to the Director for consideration. These changes are made in accordance with 45 CSR 13. Therefore, this writer recommends the Director to grant Union Carbon Corporation a Permit to Construct a treatment process unit to treat contaminated groundwater at the South Charleston Site.